



Original Article

Oral Health Inequalities in Southwest Andalusian Children: The Role of MIH and Dental Caries

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ABSTRACT

Children's oral health is commonly affected by dental caries and molar–incisor hypomineralisation (MIH), conditions that can impair chewing, appearance, and social well-being. In Spain, variations in prevalence have been observed across regions and social groups, especially in rural settings and among children with immigrant backgrounds. This study aimed to examine the presence of dental caries and MIH in 6 to 7-year-old children from the towns of Mazagón; Palos de la Frontera, and San Bartolomé, identifying social and clinical factors linked to oral health disparities. A total of 229 children from primary schools participated in this cross-sectional survey. Clinical examinations assessed dental status, while structured interviews gathered anthropometric, sociodemographic, and behavioural data. Associations between risk factors and outcomes were explored using univariate and multivariate logistic regression. The Huelva Ethics Committee approved the study protocol. More than half of the participants (53.3%) presented with caries (DMFT ≥ 1), with mean DMFT and dft values of 1.78 and 0.31, respectively. MIH was diagnosed in 32.8% of the children, predominantly affecting the first permanent molars (teeth 36 and 26). Regression analyses indicated that caries was independently linked to African (OR = 7.47; 95% CI: 2.84–23.8) and European (OR = 4.56; 95% CI: 1.26–22.3) parental origin, poor oral hygiene (OR = 3.07; 95% CI: 1.60–6.03), and the presence of MIH (OR = 3.20; 95% CI: 1.64–6.42). Children living in San Bartolomé had increased odds of MIH (OR = 2.90; 95% CI: 1.21–7.45). The Condado-Campaña region exhibits elevated levels of caries and MIH, surpassing national averages, reflecting inequities shaped by social factors (migrant status, residence) and oral health conditions (hygiene, MIH). Preventive strategies, including culturally adapted oral health education and equitable access to dental care, are urgently needed for vulnerable populations.

Keywords: Molar–incisor hypomineralisation, Pediatric oral health, Dental caries, Social disparities, Migration

Introduction

Healthy teeth and gums during early childhood are crucial not only for proper physical growth but also for emotional balance, social engagement, academic success, and long-term quality of life. Problems in dental health at a young age can trigger both immediate and persistent negative effects across these domains [1, 2]. One of the most common oral disorders worldwide is dental caries, affecting roughly 520 million children and adolescents, with an average annual increase of 6.7% since 2010 [3]. In Spain, approximately 20.6% of children aged 5 to 15 are affected, although prevalence varies by region and social background [4].

Caries is a progressive, non-infectious disease influenced by bacterial biofilms and dietary habits, causing mineral loss in teeth and lesion formation [5]. Its onset and progression are shaped by a complex interplay of biological, behavioural, psychosocial, and environmental factors. Major contributors include high sugar consumption, poor oral hygiene, limited fluoride or nutrient intake, and restricted access to preventive dental care [6, 7]. Additionally, social, cultural, and geographic determinants complicate efforts to control the disease [8]. Untreated caries may lead to pain, infection, and difficulty chewing, negatively affecting nutrition, growth, and school performance.

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Moreover, they can diminish children's self-esteem and overall oral health-related quality of life (OHRQoL) [9-11].

Molar–incisor hypomineralisation (MIH) has become a prominent concern over the past two decades due to its high prevalence and negative impact on children's dental health. This condition is characterized by qualitative enamel defects that primarily affect the first permanent molars and frequently the permanent incisors. Affected teeth may show opacities, enamel breakdown, and increased sensitivity [12, 13]. Globally, MIH is estimated to affect 13.5% of children (95% CI: 12.0–15.1%), though prevalence differs by region, with reported rates of 18.2% in Rome, Italy, and up to 39.9% in Syria [14, 15]. In Spain, estimates range from 7% to 25% among children aged 6–14 years, influenced by regional and social factors [16, 17].

Molar–incisor hypomineralisation (MIH) has been recognised as a condition that substantially increases children's vulnerability to dental caries, especially in its more severe forms. In addition to higher caries risk, MIH can cause persistent tooth pain, pronounced sensitivity, and often necessitates advanced dental treatments. These effects not only reduce children's oral health-related quality of life but also impose significant emotional and financial pressures on families and healthcare systems [18]. Although the underlying causes of MIH are not fully clarified, research suggests that early-life health complications and maternal illnesses during pregnancy may be contributing factors [19].

This investigation focused on children aged 6 to 7 years, a critical period for evaluating dental caries and MIH. At this stage, children have a mixed dentition that includes both primary teeth and newly erupted permanent molars. Studying this transitional period enables early identification of oral health problems, implementation of preventive measures, and assessment of the relationship between MIH and caries in the context of sociodemographic and behavioural factors.

The purpose of this cross-sectional study was to describe the oral health status of 6–7-year-old children in the Condado-Campiña area with a focus on the prevalence of dental caries and MIH. Additionally, the study aimed to explore associations between these conditions and variables such as sociodemographic characteristics, anthropometric measurements, and oral hygiene behaviours. By providing locally specific data, the study contributes to ongoing discussions regarding the causes of MIH and complements prior research limited by geographic and methodological constraints [20].

Materials and Methods

Study design and setting

A cross-sectional, observational, and analytical study was carried out in three municipalities in Mazagón, Palos de la Frontera, and San Bartolomé, all part of the Condado-Campiña Health District.

Data collection included intraoral examinations of school-aged children, accompanied by brief structured interviews and measurements of height and weight. The interviews gathered information about parental nationality and children's oral hygiene routines.

Clinical assessments were conducted within school facilities, with support from teaching staff. Each location provided a room that ensured privacy, adequate lighting (both artificial and natural), and functional furniture suitable for conducting oral examinations.

Participants

Children aged 6–7 years attending public primary schools (CEIP) in the selected municipalities formed the study population. Eligible participants were randomly selected from school enrollment lists, and participation was contingent upon parents or guardians providing written informed consent.

Exclusions applied only to children whose medical conditions made standard dental assessments impractical in a school setting or whose guardians declined involvement. No further restrictions were imposed, allowing maximal participation and improving the representativeness of the findings.

Variables

Main outcomes

Dental Caries: The presence of dental caries was determined through visual intraoral examination using a standard dental mirror, in accordance with World Health Organization (WHO) oral health survey guidelines [21]. Caries status was noted as a binary variable (yes/no), and the number of teeth affected was recorded as a discrete quantitative variable, differentiating between primary and permanent teeth.

Molar–Incisor Hypomineralisation (MIH): MIH was diagnosed according to the criteria established by the European Academy of Paediatric Dentistry (EAPD) [22].

Explanatory variables

The study included the following factors: sex (male/female), municipality of residence, school, oral hygiene routines, weight, height, and body mass index (BMI).

Additional measures

Secondary metrics included the dft index (decayed and filled teeth in primary dentition), DMFT index (decayed, missing, and filled teeth in permanent dentition), and restoration index.

Data sources and collection

Information from dental examinations, structured interviews, and anthropometric measurements was first documented on pre-designed collection sheets, then entered into a dedicated Microsoft Excel®2021 database. All variables were assigned systematic codes to maintain data accuracy, ensure internal consistency, and allow traceability during the analysis process.

Height and weight were measured by the school nurse and a local paediatrician. Each tooth was evaluated individually, with permanent teeth recorded alongside corresponding primary teeth when both were present. Permanent teeth were assigned numerical codes, whereas primary teeth were denoted with letters in parentheses. Upon completing data collection, the dataset was exported to R software version 4.5 for statistical analysis.

Sample size

The study's participant number was determined to support the creation of a predictive model for dental caries or MIH, based on Riley *et al.*'s methodology [23]. The intended model aimed for a Cox–Snell R^2 of 0.3, incorporated five potential predictors, and applied a shrinkage factor of 0.9 for validation within the dataset.

With an expected outcome frequency of 15%, a minimum of 196 children was needed. Anticipating that approximately 10% might not respond or complete the study, the recruitment goal was increased to 216 participants.

Statistical analysis

Numerical variables were summarized using either the mean with standard deviation or the median with interquartile range, depending on their distribution pattern. Categorical data were expressed as counts and percentages. The Shapiro–Wilk test was employed to examine normality.

To investigate potential links between independent factors (municipality, sex, oral hygiene, BMI) and outcomes (MIH, dental caries), bivariate analyses were conducted. The statistical test was chosen according to the type of variable: chi-square or Fisher's exact test for categorical variables, and Student's t-test, ANOVA, or non-parametric tests (Kruskal–Wallis, Wilcoxon) for continuous variables.

Predictor variables identified in these analyses were included in multivariable logistic regression models to determine their independent associations with caries and MIH while adjusting for confounding effects. Outcomes were presented as adjusted odds ratios (OR) with 95% confidence intervals.

Collinearity between predictors was evaluated using the variance inflation factor (VIF). All statistical testing was two-sided, and p-values below 0.05 were considered statistically significant. Analyses were performed in R version 4.5 [24].

Ethical framework

The research was endorsed by the Huelva Ethics Review Panel (SICEIA-2024-003240) and aligned with international ethical principles, the EU Data Protection Regulation (GDPR 2016/679), and Spain's Law 3/2018 on data privacy. Involvement was voluntary, with guardians or parents signing consent forms after receiving comprehensive details about the study's aims and processes.

Study outcomes

Participant profile

As detailed in **Table 1**, the study encompassed 229 children, of which 200 (87.3%) were 6 years old and 29 (12.7%) were 7 years old. Boys slightly outnumbered girls (53.7% vs. 46.3%). The primary location of residence was San Bartolomé (26.2%), followed by Palos de la Frontera (54.6%), and Mazagón (19.2%). Most parents were of Spanish origin (73.8%), with a notable share of African descent (17.0%). Regarding physical metrics, the children's average weight was 24.5 kg (SD = 5.7), and their average height was 122.6 cm (SD = 4.7). The mean BMI was 16.2 kg/m² (SD = 3.0). Overweight was observed in 10.0% of the sample, while obesity affected 6.1%.

Table 1. Sociodemographic and Physical Attributes of Participants by Age Cohort

Characteristic	6 Years (n = 200)	7 Years (n = 29)	Total (n = 229)
Gender			
Girls	90 (45.0%)	16 (55.2%)	106 (46.3%)
Boys	110 (55.0%)	13 (44.8%)	123 (53.7%)
Residential Area			
Mazagón	40 (20.0%)	4 (13.8%)	44 (19.2%)
Palos de la Frontera	107 (53.5%)	18 (62.1%)	125 (54.6%)
San Bartolomé	53 (26.5%)	7 (24.1%)	60 (26.2%)
Parental Heritage			
Spanish	148 (74.0%)	21 (72.4%)	169 (73.8%)
European	14 (7.0%)	2 (6.9%)	16 (7.0%)
African	34 (17.0%)	5 (17.2%)	39 (17.0%)
American	4 (2.0%)	1 (3.4%)	5 (2.2%)
Weight (kg)			
Range	15.7–67.5	20.1–33.0	15.7–67.5
Average (SD)	24.5 (6.0)	24.1 (3.5)	24.5 (5.7)
Height (cm)			
Range	105.0–138.0	118.0–139.0	105.0–139.0
Average (SD)	122.6 (4.8)	122.9 (4.4)	122.6 (4.7)
BMI (kg/m²)			
Range	11.8–37.0	13.0–20.2	11.8–37.0
Average (SD)	16.2 (3.1)	16.0 (1.8)	16.2 (3.0)
Median (Q1–Q3)	15.5 (14.5–17.2)	16.0 (14.7–16.9)	15.6 (14.5–17.1)
BMI Category			
Severe Undernutrition	3 (1.5%)	1 (3.4%)	4 (1.7%)
Moderate Undernutrition	7 (3.5%)	1 (3.4%)	8 (3.5%)
Healthy Weight	157 (78.5%)	23 (79.3%)	180 (78.6%)
Overweight	19 (9.5%)	4 (13.8%)	23 (10.0%)
Obese	14 (7.0%)	0 (0.0%)	14 (6.1%)

[†] n (%).

Frequency of caries and related variables

Analysis of the primary teeth showed that carious lesions predominantly affected the posterior molars. The highest lesion counts were observed in teeth 74 (51), 85 (50), 75 (49), and 84 (49), followed by 55 (48), 54 (43), and 65 (43). In contrast, anterior teeth were much less affected: tooth 64 had 30 lesions, 53 had three, 83 had two, 63 had one, and 73 had none (**Figure 1**).

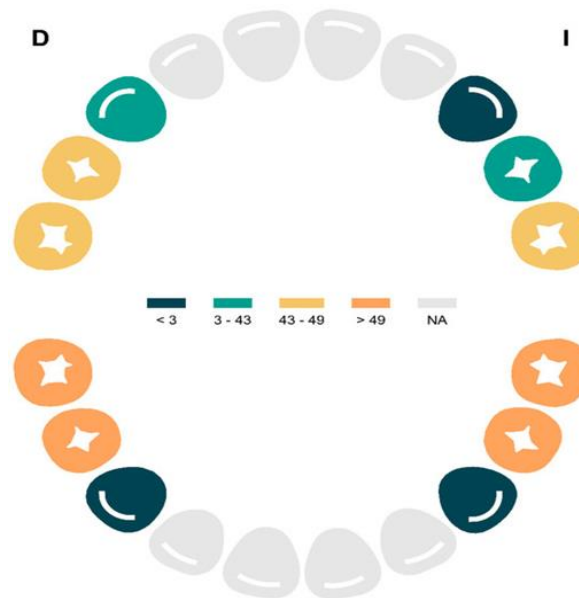


Figure 1. Distribution of Carious Lesions by Primary Tooth. NA = Not Affected.

For the permanent teeth, first molars were the most vulnerable. Tooth 26 had 20 lesions, teeth 36 and 46 had 15 each, and tooth 16 had 12.

Out of the total 229 children, 122 (53.3%) had at least one carious tooth. When examining potential links between participant characteristics and a DMFT index ≥ 1 , parental origin was significant ($p < 0.001$). Among children without caries, 89.7% had Spanish parents, compared to 59.8% among children with caries. Conversely, the proportion of children with parents of African origin rose from 4.7% in the caries-free group to 27.9% in those with caries. No significant differences were found in sex ($p = 0.235$), municipality of residence ($p = 0.145$), weight ($p = 0.902$), height ($p = 0.429$), or BMI ($p = 0.997$). Both inadequate oral hygiene and molar-incisor hypomineralisation were strongly associated with having a DMFT index ≥ 1 ($p < 0.001$) (**Table 2**).

Table 2. Sociodemographic and Anthropometric Factors Associated with Dental Caries.

Characteristic	Dft = 0 (n = 107)	Dft ≥ 1 (n = 122)	p-Value
Gender			0.235
Girls	54 (50.5%)	52 (42.6%)	
Boys	53 (49.5%)	70 (57.4%)	
Parental Heritage			<0.001
Spanish	96 (89.7%)	73 (59.8%)	
European	3 (2.8%)	13 (10.7%)	
African	5 (4.7%)	34 (27.9%)	
American	3 (2.8%)	2 (1.6%)	
Residential Area			0.145
Mazagón	26 (24.3%)	18 (14.8%)	
Palos de la Frontera	57 (53.3%)	68 (55.7%)	
San Bartolomé	24 (22.4%)	36 (29.5%)	
Weight (kg)	23.4 (21.0, 25.5)	23.0 (21.5, 26.0)	0.902
Height (cm)	122.0 (119.5, 125.0)	121.0 (120.0, 124.5)	0.429
BMI (kg/m²)	15.32 (14.55, 16.92)	15.66 (14.33, 17.24)	0.997
Oral Hygiene Status			<0.001
Adequate	51 (47.7%)	22 (18.0%)	
Inadequate	56 (52.3%)	100 (82.0%)	
MIH Status			<0.001
No MIH	88 (82.2%)	69 (56.6%)	

MIH Present	19 (17.8%)	53 (43.4%)
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Notes: 1 n (%); Median (Q1, Q3). 2 Chi-square test for association; Fisher's exact test; Wilcoxon Signed-Rank Test.

In the single-factor analysis, strong connections were identified between tooth decay and variables like ancestral background, dental care quality, and MIH occurrence. Children of African lineage showed a substantially increased likelihood of decay (OR = 8.94; 95% CI: 3.62–27.1; $p < 0.001$), followed by those with European roots (OR = 5.70; 95% CI: 1.76–25.5; $p = 0.008$) compared to those with Spanish ancestry. Inadequate dental hygiene (OR = 4.14; 95% CI: 2.30–7.64; $p < 0.001$) and MIH (OR = 3.56; 95% CI: 1.96–6.68; $p < 0.001$) were also closely linked to higher decay rates. The areas of Palos de la Frontera (OR = 1.72; $p = 0.126$) and San Bartolomé (OR = 2.17; $p = 0.056$) hinted at a slightly elevated risk, though these findings did not reach statistical significance (**Table 3**).

Table 3. Elements Influencing Tooth Decay: Results from Single-Factor and Multi-Factor Evaluations.

Variable	Univariate Model			Multivariate Model		
	OR	95% CI	p-value	OR	95% CI	p-value
Gender						
Female	—	—	—	—	—	—
Male	1.37	0.81–2.32	0.235	1.29	0.70–2.38	0.415
Parental Origin						
Spain	—	—	—	—	—	—
Europe	5.70	1.76–25.5	0.008	4.56	1.26–22.3	0.033
Africa	8.94	3.62–27.1	<0.001	7.47	2.84–23.8	<0.001
America	0.88	0.11–5.42	0.887	1.01	0.12–7.49	0.992
Municipality						
Mazagón	—	—	—	—	—	—
Palos de la Frontera	1.72	0.86–3.50	0.126	2.09	0.93–4.87	0.079
San Bartolomé	2.17	0.99–4.85	0.056	2.46	0.98–6.38	0.059
Oral Hygiene						
Good	—	—	—	—	—	—

Abbreviations: CI = Confidence Interval, OR = Odds Ratio.

In the multi-factor analysis, African lineage (OR = 7.47; 95% CI: 2.84–23.8; $p < 0.001$) and European lineage (OR = 4.56; 95% CI: 1.26–22.3; $p = 0.033$) remained robust predictors of tooth decay. Poor dental care practices (OR = 3.07; 95% CI: 1.60–6.03; $p < 0.001$) and MIH (OR = 3.20; 95% CI: 1.64–6.42; $p < 0.001$) continued to demonstrate significant associations, highlighting their importance as primary risk contributors. Geographic variations showed slightly diminished effects (Palos de la Frontera: OR = 2.09; $p = 0.079$; San Bartolomé: OR = 2.46; $p = 0.059$), and gender showed no meaningful impact ($p > 0.05$) (**Table 3**).

Decay metrics

The dft index was calculated at 1.78 (95% CI: 1.65–1.95), while the DMFT index stood at 0.31 (95% CI: 0.23–0.38) (**Table 4**). Based on the count of decayed and filled teeth in both primary and permanent dentition, the estimated treatment requirement was 0.90 (95% CI: 0.87–0.93), with a restoration index of 0.1 (95% CI: 0.07–0.13).

Table 4. Tooth Decay Indices for Primary and Permanent Teeth.

Index	Decayed Teeth	Missing Teeth	Filled Teeth	Mean (95% CI)
dft	369	—	39	1.78 (1.65–1.95)
DMFT	62	0	8	0.31 (0.23–0.38)

Molar–incisor hypomineralisation prevalence and associated variables

Assessment of MIH in primary teeth revealed that the posterior molars were most frequently affected. Tooth 85 had the largest number of cases, totaling 17, followed by 75 with 11, 65 with nine, and 55 with eight affected

teeth. In permanent teeth, the first molars showed the highest involvement: tooth 36 had 22 cases, tooth 26 had 18, tooth 16 had 17, and tooth 46 had 14. Among the lower central, anterior teeth and lateral incisors (31, 32, 41, 42) were less commonly affected, with six, six, four, and six cases, respectively. The upper incisors (11, 12, 21, 22) were the least impacted, showing three, two, two, and two cases (**Figure 2**).

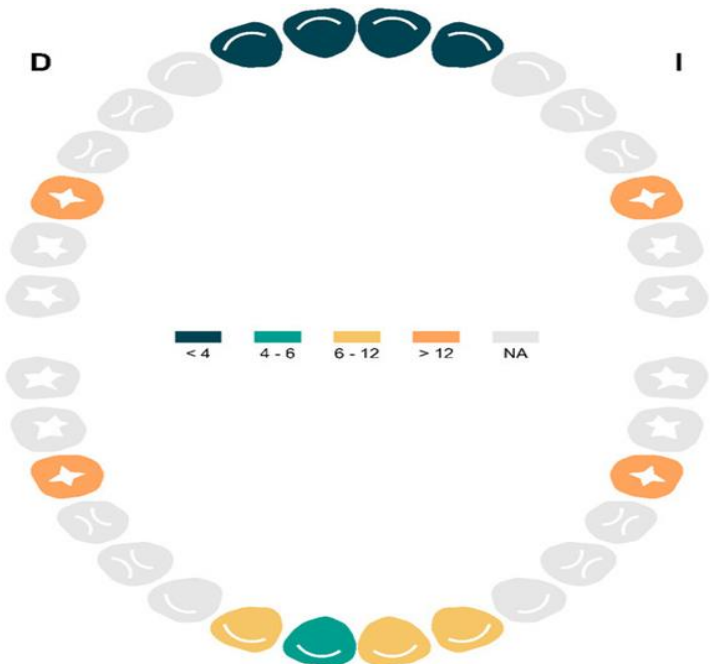


Figure 2. Frequency of Molar–Incisor Hypomineralisation by Tooth in Permanent Dentition. NA = Not Affected.

Table 5 shows the associations between sociodemographic and anthropometric characteristics and MIH prevalence. None of the characteristics reached statistical significance (all $p > 0.05$). However, some tendencies were noticeable: children with MIH more often had poor oral hygiene (76.4% vs. 64.3%; $p = 0.069$) and were more frequently from San Bartolomé (34.7% vs. 22.3%; $p = 0.066$).

Variable	MIH Status		p-value ²
	Healthy (n = 157) ¹	Present (n = 72) ¹	
Gender			0.446
Female	70 (44.6%)	36 (50.0%)	
Male	87 (55.4%)	36 (50.0%)	
Parental Origin			0.430
Spain	120 (76.4%)	49 (68.1%)	
Europe	9 (5.7%)	7 (9.7%)	
Africa	24 (15.3%)	15 (20.8%)	
America	4 (2.5%)	1 (1.4%)	
Municipality			0.066
Mazagón	35 (22.3%)	9 (12.5%)	
Palos de la Frontera	87 (55.4%)	38 (52.8%)	
San Bartolomé	35 (22.3%)	25 (34.7%)	
Weight (kg)	23.2 (21.0–26.7)	23.5 (22.1–24.8)	0.424
Height (cm)	121.0 (119.5–125.0)	122.0 (120.0–125.0)	0.404
BMI (kg/m²)	15.35 (14.51–17.16)	15.89 (14.48–16.67)	0.633

Oral Hygiene			0.069
Good	56 (35.7%)	17 (23.6%)	
Poor	101 (64.3%)		

ln (%); Median (Q1, Q3). ² Chi-square test of independence; Fisher's exact test; Wilcoxon Signed-Rank Test.

Analysis of potential determinants of MIH revealed that children living in San Bartolomé had notably higher odds of presenting with MIH than those from Mazagón, which served as the reference category. Specifically, the univariate model showed an odds ratio of 2.78 (95% CI: 1.17–7.08; $p = 0.025$). When controlling for other variables in the multivariate model, the elevated risk persisted (OR = 2.90; 95% CI: 1.21–7.45; $p = 0.021$). For residents of Palos de la Frontera, there was a slight upward trend in risk, although it did not reach statistical significance (univariate OR = 1.70, $p = 0.209$; multivariate OR = 1.81, $p = 0.161$). Additionally, children with suboptimal oral hygiene appeared somewhat more likely to have MIH, showing borderline significance in both univariate (OR = 1.79, $p = 0.071$) and adjusted analyses (OR = 1.85, $p = 0.060$) (**Table 6**).

Table 6. Univariate and Multivariate Associations Between Risk Factors and Molar–Incisor Hypomineralisation

Variable	Univariate Model			Multivariate Model		
	OR	95% CI	p-value	OR	95% CI	p-value
Province / Municipality						
Mazagón	—	—	—	—	—	—
Palos de la Frontera	1.70	0.77–4.07	0.209	1.81	0.81–4.38	0.161
San Bartolomé	2.78	1.17–7.08	0.025	2.90	1.21–7.45	0.021
Oral Hygiene Status						
Good	—	—	—	—	—	—
Poor	1.79	0.97–3.45	0.071	1.85	0.99–3.60	0.060

Abbreviations: CI = Confidence Interval; OR = Odds Ratio.

Results and Discussion

Principal observations

This investigation focused on the oral health of children aged 6–7 years in the Condado-Campiña region, concentrating on both dental caries and molar–incisor hypomineralisation (MIH). Over half of the children (53.3%) exhibited at least one decayed or filled tooth (dft/DMFT ≥ 1). Analysis of the affected teeth showed distinct patterns: in the primary dentition, the posterior molars—teeth 74, 85, 75, and 84—were most frequently involved, whereas in permanent dentition, the first molars (teeth 26, 36, and 46) were the main sites of caries. Disease severity appeared relatively low, with a dft index of 1.78 and a DMFT index of 0.31, but the low restoration index (0.1) highlighted unmet treatment needs.

Parental origin strongly influenced caries risk. Children whose parents were from Africa were considerably more likely to develop caries than those with Spanish parents (adjusted OR = 7.47; 95% CI: 2.84–23.8; $p < 0.001$). Similarly, children with parents from other European nations—primarily Romania and Bulgaria—had an increased likelihood of caries (adjusted OR = 4.56; 95% CI: 1.26–22.3; $p = 0.033$). Beyond these demographic factors, poor oral hygiene (adjusted OR = 3.07; 95% CI: 1.60–6.03; $p < 0.001$) and the presence of MIH (adjusted OR = 3.20; 95% CI: 1.64–6.42; $p < 0.001$) independently predicted higher caries prevalence.

MIH affected 75 children in the study sample, accounting for 32.8% of participants. First permanent molars—particularly teeth 36 and 26—were the teeth most often impacted. Children residing in San Bartolomé had a statistically significant higher risk of MIH (OR = 2.90), while poor oral hygiene showed a borderline association (OR = 1.85; $p = 0.060$), suggesting a potential contributory role that deserves further study.

Contextualizing findings with previous research

The rate of dental caries in this study's population is substantially higher than what has been documented in Spain at both national and regional levels. National surveys from 2020 indicate that roughly 28.3% of 5–6-year-old children have a DMFT score above zero. Among socioeconomically disadvantaged groups, the prevalence rises sharply to 47.3%, and among children born outside Spain, it reaches 59.8% [4]. In contrast, the Condado-Campiña

sample of 6–7-year-olds exhibited a markedly higher prevalence, exceeding national figures for Spanish children aged 2–10 years (21–25%) [25]. This disparity likely reflects the district's population structure, particularly its higher proportion of migrant families.

Looking specifically at Andalusia, our results mirror reported intra-regional differences. The Fifth Epidemiological Survey of Oral Health in schoolchildren recorded a prevalence of 41.4% among 7-year-olds [26]. Local data, however, show considerable variation, from as low as 21.7% in Granada to 53.19% in Lebrija and El Cuervo (Huelva) [20, 27]. With a 53.3% prevalence, Condado-Campiña aligns with the upper end of this range. This pattern may be linked to socioeconomic inequality and limited access to preventive dental services. The low restoration index in our cohort (10%)—well below the national average of 27.1% [4]—further emphasizes the need for expanded therapeutic and preventive care.

Parental origin proved to be a major factor influencing caries risk. Children of African descent were most affected (OR = 7.47), followed by those whose parents came from other European countries, primarily Romania and Bulgaria (OR = 4.56). These outcomes corroborate national and international findings that identify migrant status as a significant determinant of oral health. For instance, analysis of the 2017 Spanish National Health Survey demonstrated that children from immigrant families are roughly twice as likely to experience dental caries, independent of socioeconomic status [28]. Regional studies reinforce this conclusion, consistently showing higher caries prevalence among migrant children across both dentitions, with parental origin emerging as a key variable in multivariate analyses [29–31].

Across European countries, the proportion of immigrant children with caries in primary teeth varies dramatically, reported between 22% and 88.7% [32]. These discrepancies largely reflect differences in access to preventive dental services and underlying socioeconomic conditions. Some populations face language or cultural obstacles, while others may lack even basic health coverage. In our sample, the elevated caries risk among children of African descent is higher than generally described in previous studies, possibly due to local influences such as dietary habits with high sugar intake or culturally specific oral hygiene practices [33, 34].

In this study, poor oral hygiene was present in 68.1% of children ($n = 156$) and was strongly associated with caries development (OR = 3.07; $p < 0.001$). This observation aligns with established evidence linking inadequate plaque removal to the overgrowth of *Streptococcus mutans* and other acidogenic bacteria, which are key drivers of enamel demineralisation and caries formation [1, 35].

The significance of oral hygiene is amplified in populations with diverse sociodemographic backgrounds. Prior research indicates that children from migrant families, particularly those experiencing socioeconomic hardship, tend to brush their teeth less frequently [36]. For instance, a study in Melilla showed that 41.6% of immigrant children brushed infrequently [34]. Such behaviors may be shaped by cultural perceptions of preventive care or by the absence of dental guidance tailored to migrant communities.

Molar–incisor hypomineralisation (MIH) was also identified as an independent risk factor for caries in this cohort (OR = 3.20; $p < 0.001$). Children with MIH are more likely to develop caries in permanent teeth, especially first molars, where severe cases can lead to a fourfold increase in dentine lesions. This is attributed to the inherent fragility of hypomineralised enamel, which promotes post-eruptive breakdown and creates uneven surfaces that favor bacterial adhesion and plaque buildup. Laboratory studies indicate that MIH-affected enamel has 18–30% lower mineral content compared to healthy enamel, accelerating demineralisation under acidic conditions. Additionally, tooth hypersensitivity in MIH can limit effective oral hygiene, perpetuating the cycle of dental deterioration [18, 37–39].

Molar–incisor hypomineralisation (MIH) shows considerable variation both worldwide and within countries, shaped by differences in diagnostic practices and environmental influences. A meta-analysis of 116 studies estimated the global MIH prevalence at 13.5% (95% CI: 12.0–15.1), with the Americas showing the highest rates at 15.3%, while Asia reported the lowest at 10.7% [12]. Within Spain, prevalence varies notably by region. In Madrid, MIH affected 28.6% of children aged 8–11, with girls representing 60.7% of cases and upper first molars involved in 74.3% [40]. Catalonia presented a lower prevalence of 12.2%, showing no significant difference between native and immigrant populations [41]. Remarkably, the towns of Lebrija and El Cuervo (Huelva) have recorded the highest MIH prevalence in Spain at 39.61%. One possible explanation for these disparities is the inconsistent use of the 2003 MIH diagnostic criteria, which a global meta-analysis associated with increased variability in results ($p = 0.0066$) [12].

In this study, tooth 36 was the most frequently affected molar. MIH does not manifest uniformly across teeth, which helps explain the differences in frequency and severity observed. Factors such as geographic location, environmental exposures, and diagnostic approaches contribute to this variability. Additionally, as the first

permanent molar to erupt, tooth 36 is often a focal point in epidemiological studies, making it more likely to be assessed and reported as affected [20, 22, 41-43].

The etiology of MIH appears to be multifactorial. Prenatal and perinatal events—such as maternal illnesses, medication exposure during pregnancy, preterm birth, and birth complications—have been linked to MIH, albeit with modest effect sizes [42]. During early childhood, recurrent illnesses including fever, asthma, and pneumonia may increase MIH risk, likely by interfering with enamel formation during critical developmental stages [43]. Evidence from Catalonia indicates that children with hypomineralisation in second primary molars (HSPM) are 2.6 times more likely to develop MIH, suggesting a shared biological susceptibility [41].

While behavioral and socioeconomic factors, such as maternal alcohol use or ethnic background, have been proposed as contributors, these associations remain weak due to methodological limitations, inconsistent confounder adjustment, and variability in exposure measurement [43]. To clarify MIH's underlying causes, further longitudinal research using standardized protocols is needed.

Strengths and limitations

A key advantage of this research is the sampling approach, which encompassed three distinct municipalities within the Condado-Campiña district. This strategy enabled the study to reflect the region's broad sociodemographic variation. Employing standardised criteria for diagnosing dental caries and MIH enhanced the reliability and repeatability of the results. Furthermore, multivariable analyses were adjusted for essential covariates, including parental origin, oral hygiene habits, and municipality, permitting the accurate identification of independent risk factors. The collection of detailed anthropometric and sociodemographic information provided a comprehensive profile of the cohort, supporting meaningful interpretation of observed differences.

Nonetheless, the study has inherent limitations. Its cross-sectional design prevents determination of causal links or temporal progression of dental caries and MIH. Additionally, the study did not gather data on children's diet, fluoride exposure, or detailed socioeconomic status, limiting the assessment of other potential risk factors. Despite efforts to ensure representative sampling, children from highly marginalised families might have been underrepresented if they did not attend the selected schools, potentially affecting the generalisability of results. Future investigations should consider longitudinal designs and include environmental exposure markers to better explore causal pathways.

Conclusion

This work offers a thorough evaluation of oral health in 6–7-year-old children in the Condado-Campiña district, revealing elevated rates of dental caries and MIH that surpass national and regional averages. The study highlights disparities, showing that children of African or European parental origin had higher caries risk, and that MIH acts as an independent predictor of caries. Critical determinants included poor oral hygiene, parental migrant status, and municipality of residence, while anthropometric measures (weight, height, BMI) were not associated with significant differences. These findings underscore the need for preventive programs that focus on high-risk populations, incorporating culturally tailored oral health education, fissure sealant application, and topical fluoride treatments, with particular emphasis on migrant and rural communities.

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